ARIZONA GRAIN RESEARCH AND PROMOTION COUNCIL
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Project Title: The use of barley in a reduced tillage cotton system

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INTRODUCTION

This study of reduced tillage, small grain-cotton rotational systems was funded jointly by the Arizona Grain Research and Promotion Council, the National Cotton Council, and the Arizona Cotton Growers Association with each organization contributing $5,000. Funding from the Arizona Grain Research and Promotion Council was used primarily to fund project activities associated with the planting and harvest of the small grain crops grown in rotation with cotton in reduced tillage experiments and demonstrations.

The no-till barley, oat and wheat crops grown as part of this project were planted using a 10 ft. wide John Deere 1590 no-till grain drill. In commercial farmer's fields, these no-till crops were compared with grain crops planted using conventional grain drills designed to plant into tilled or prepared soil. The JD 1590 no-till drill is designed to broadcast plant on a 7.5" spacing in flat or nearly level ground. Our particular 1590 drill is towed behind a tractor on a pair of 13" wide, 15" diameter front castor wheels and a pair of similar sized rear wheels that are on about a 100" spacing. In the fall of 2003, we were not able to obtain uniform barley stands for two reasons: 1) the drill is designed to plant flat and the disk openers could not reach the bottom of the furrows, and 2) the drill's rear wheels "wandered" in and out of furrows making the use of spacers on the disk opener arms in the furrows futile because the drill lines were not in consistent positions with respect to the beds.

In fall 2004, we adopted a strategy of planting only the drill lines on the top and upper shoulders of stale cotton beds and did not plant the drill lines in the furrows. We increased the seed density in the planted drill lines to obtain plant populations similar to those in conventional broadcast planted fields. In contrast to fall 2003, we also added about 22 lb of nitrogen/A the using the fertilizer hopper on the JD1590 (i.e., the dual seed and fertilizer hoppers allowed us to fertilize and plant in the same pass across the field). To make this strategy work we had to stop the drill from "wandering" behind the tractor. This was accomplished by modifying 20" diameter gauge wheels to change the relationship between the hub and rim of the wheel and by mounting truck-trailer tires on the rims. In this configuration the rear wheels were about 82" apart center to center and the drill consistently tracked behind the towing tractor. The 20" wheels had the added advantage of compensating for furrow depth so that the drill was approximately level with the small front wheels running on the bed tops and the larger rear wheels running in furrows. This assured normal seed flow and performance of the JD1590 drill. We spent about half of the $5,000 provided by the Arizona Grain Research and Promotion Council on developing these wheels and building spacers to experiment with different wheel configurations. The remaining

funds were used for grain seed, maintenance parts, miscellaneous field supplies, truck maintenance and the fuel that was used to transport the drill to our farmer cooperators.

MATERIALS AND METHODS

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A replicated (4) experiment was planted in the fall of 2004 at MAC. Treatments were:

1) winter fallow followed by early April planted cotton,
2) winter oat (Cayuse) green chop crop followed by early April planted cotton,
3) winter barley (Poco) planted flat followed by late May cotton planting, and
4) winter barley (Barcott) planted on beds followed by strip tillage and late May cotton planting.

In treatment 1 (winter fallow) the previous cotton crop was shredded, roots pulled (Sundance) and the plots disked twice to meet plow down requirements. Treatment 2 which also followed cotton was similarly treated and then oats were planted flat with the JD1590 in the normal (i.e., factory) wheel configuration. Treatment 3 was similar to treatment 2 but was planted with Poco barley (131 lb/A) using the JD1590 drill. In treatment 4 which also followed cotton, the cotton stalks were shredded and Barcott barley (129 lb/A) was planted using the JD1590 in the custom wheel configuration that planting only the drill lines on the beds. The furrows were not planted to barley. The small grains were planted on 29 November 2004 with 22 lb N/A, were grown using standard practices (including water-running UN32) and harvested on 24 May 2005. The oats were green chopped 17 March 2004 and irrigated. Cotton (DeltaPine 449BR was dry planted on 14 April 2005 in the winter fallow treatment using a 4-row Monosem planter and in the oat green chop treatments using Yetter coulter/residue managers bolted onto a 4-row John Deere 7100 MaxEmerge planter. Additional weight (about 100 lb) was added to each row units on the cotton planter to force the coulter and disk-openers to penetrate the soil adequately for planting. Cotton (DP449BR) was planted into barley residues using Yetter coulter/residue managers bolted onto a 4-row John Deere 7100 MaxEmerge planter on 25 May 2005.

Commercial Farms

The John Deere 1590 no-till grain drill was towed to 5 commercial farms in the fall and winter of 2004-2005. All of our cooperating farmers intended to plant a small grain crop on stale cotton beds after they shredded the cotton stalks. Four cooperators successfully used the drill to plant either barley (Tom Clark in Marana) or wheat (Paul Grasty in Casa Grande, Mike Urton in Coolidge and Bill Stanbaugh in Mammoth). They all used the custom 20" wheel configuration of the JD1590 drill discussed above and planted the drill lines on the beds but not the drill lines in the furrows. All of these cooperators applied nitrogen (e.g., 11-53-0) in the planting operation with the drill and water ran additional nitrogen (e.g., UN-32). One cooperator tried to use the drill in moist soil conditions, was not successful, and decided not plant with the JD1590. Tom Clark was interested in following the Solum barley with cotton but the cool spring, delays in custom harvesting and a potential cotton planting date after a May 15 cutoff date for crop insurance caused him to not plant the cotton.

RESULTS AND DISCUSSION

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Of interest at MAC was the yield comparison between the Poco barley planted on the flats and the Barcott barley planted on stale cotton beds. The Poco barley on the flat significantly out yielded the Barcott barley on beds, 5,069 lb/A versus 4,176 lb/A, respectively. Both were respectable yields and greatly exceeded the yields we have obtained in the past with Solum barley. We do not know if the yield differences were due to the different planting configurations (on the flat versus on beds) or due to differences in the barley varieties. In fall 2005 we hope to plant the same barley variety using the two different planting configurations. Both barley varieties produced enough biomass to completely cover the soil surface with residues after harvest which appears to be a prerequisite for successful cotton planting.

Cotton (DP449BR) was dry planted in treatments 1, 2 and 3 at MAC. In the conventionally planted cotton (treatment 1), the cotton was dry planted and irrigated to germinate the seed. Unfortunately, the field was irrigated at night and the irrigator allowed water to go over the tops of some beds reducing the cotton population in some parts of the plots. Sufficient plant populations were obtained in some 4 row strips so yield measurements can be made this fall. In the Cayuse oat green chop treatment, the amount of oat residue on the soil surface was small, about 30 to 40% cover with covered areas having a shallow residue depth. After cotton planting on the flat and flood irrigation, the soil surface rapidly dried and formed a crust in treatment 2. Thus, a poor cotton stand was obtained in most of the plot area that would dramatically reduced cotton yields so this treatment was not irrigated again after the three germinating irrigations. The cotton planted into barley residues (Poco in treatment 3) successfully germinated due to the nearly complete residue cover on the soil and good cotton field populations were obtained. Cotton yields will be measured this fall after defoliation. Over the past several years we have successfully planted cotton into barley residues on stale beds using the Yetter coulter/residue managers. However, cotton was not planted in treatment 4 as intended because running the Bigham strip tillage implement in dry soil prior to planting cotton destroyed the beds. Our intention was to use this implement to rip the middle of the beds, reform the beds with disk-listers, and mulch the bed with a soil conditioner. As we anticipated, some soil moisture is necessary to be able to run this strip tillage implement without destroying the beds. Experiments are underway at MAC to test the implement at various soil moisture levels on stale beds in treatment 4.

Commercial Farms

Our four grower cooperators were relatively pleased with the performance of the John Deere 1590 no-till grain drill used with the custom 20" wheel configuration that only planted the drill lines on the beds. Tom Clark (Marana) obtained Solum barley yields of 4,200 and 4,400 lb/A from seeding rates of 50 lb/A. These fields compared favorably with a nearby conventionally planted Solum barley field that yielded 3208 lb/A and with yields he has obtained from conventionally planted Solum barley in these fields in the past. Similarly Bill Stanbaugh obtained a Sky wheat yield of 4,767 lb/A in north half of a field planted with the JD1590 compared to 5,249 lb/A in the south half of a field planted with a conventional grain drill. Bill's field had a soil texture gradient with the soil becoming coarser (i.e., more sand and gravel) going from south to north towards Aravaipa Creek. Bill considered the yields essentially equivalent given the change in soil texture.

Mike Urton planted Mohawk Durum wheat using the JD1590 on 9.45 acres of a field using the 20" wheel configuration that planted only drill lines on the beds (minimum till) and compared this to the remaining 26.5 acres of the field planted with his conventional drill (conventional till). The minimum till wheat was planted 29 November following shredding of the cotton stalks on 4 November. This seed was germinated and a 100% stand was obtained from 0.85 inches of rain on 4 to 6 December. This rain delayed disking of the conventional till field until 15 December. After spreading fertilizer, disking a second time, listing with a disk lister, and using a cultipacker or ring roller on 16 to 18 December, the conventional till field was planted. Both sections of the fielding were irrigated on 21 to 24 December. Mike compiled the following summary.

Mohawk Durum Wheat Production on Urton Farms, Coolidge, AZ.			
Crop Inputs		Minimum Till	Conventional Till
	Total Nitrogen	293 lb/A	307 lb/A
	Total P2O5	165 lb/A	67 lb/A
	Total Irrigation	31.8 acre-inches/A	36.9 acre-inches/A
Harvest Parameters			
	Grain Yield	3.94 tons/A	4.07 tons/A
	% Protein	13.1%	13.2%
	Bushel weight	64 lb	63.5 lb
	% Moisture	6.7%	7.6%

Mike noted "Timeliness of reduced tillage a benefit as no-till grain brought to a complete stand by early rain. Tillage of conventional grain delayed by same rain". He did not observe differences in the quantity of water applied in the first irrigation (about 10 acre-inches/A) despite the cotton residues in the minimum till portion of the field. Mike further noted "Able to eliminate final irrigation, and one fertilizer application on minimum till. Yield and quality nearly identical. Significant savings in land preparation with minimum till".

In summary, the results of our first year of planting drill lines on stale beds with shredded cotton stalks using the John Deere 1590 no-till grain drill with modified 20" rear wheels were encouraging. It appears that comparable yields can be obtained with this planting method as with conventional land preparation and planting. Thus, considerable expense (about $40 to $50/A) and time can be saved using a notill planter to make the transition from cotton to small grain crops. Past experiments and the Maricopa data indicate that cotton can be planted into barley stubble on beds and on the flat if there are sufficient residues to cover the soil surface to inhibit soil crusting. More work is necessary to investigate strip-till practices in barley-cotton double crop rotations and to gather more agronomic and economic data. We look forward to another year of experimentation.